

Field-notes from Afghánistán: (No. 4)—from Túrkestán to India,
by C. L. GRIESBACH.

Introduction.—The return march of the Afghán Boundary Commission to India, over the Hindu Kúsh and through Kabul, completed my geological reconnaissance of Afghánistán, and it has in a certain degree connected my work with that of my colleagues on the north-western frontier of India.

As I have had nearly always to conform closely to the movements and march of the Commission, opportunities for geological observations were naturally extremely limited, but my chief regret in connection therewith is, that I could not devote more time to the country lying north of the Hindu Kúsh.

I received permission to march to Charikár in advance of the Mission head-quarters, which moved two days behind me. I therefore left the Tangi Shadián (south-east of Balkh) on the 18th September 1886, and marched through Tashkhurghan and Haibak to Ghorí, which is one of the districts of Badakhshán. Thence I went over the Chahárdar pass to Siáh Gird, from where I made an excursion to Farinjal. From Búrj-i-Gúl-Ján I was recalled to meet H. B. M.'s Commissioner at Siáh Gird. The remainder of the march to India brought us through Charikár and Kabul by the Khaibar route to Peshawar, where we arrived on the 1st November, having altogether been absent from India two years and two months.

Physical Geography.—Regarding the geographical features of the country north of the Hindu Kúsh which I traversed on this return march, there is little to say in addition to the description given in my last paper of the area between Bamián and Tashkhurghan.

Between Haibak and the Chahárdar pass I crossed the south-west corner of Badakhshán, the general physical characters of which may be said to be a continuation of the country between Haibak and the main watershed. It is drained by the headwaters and affluents of the Kundúz and Aksarai rivers; the latter in its upper course being known as the Súrkh Rúd. I had to cross its main branch near Dahána Iskár, where I found it a considerable volume of water, flowing in a deep valley of erosion. Numerous smaller streams drain from the main range of the Hindu Kúsh into the Súrkh Rúd, and most of these deep branch-valleys form routes to and over the Hindu Kúsh into the valley of the Ghorband river, which with its many branches forms one of the headwaters of the Kabul river.

Orographical and geotectonic features.—The outline description which I have given of the ranges between Bamián and the Túrkestán plain in my former report, equally applies to the entire section between India and the Oxus, as far as regards the general character and origin of the hill ranges. That is to say, it is a more or less continuous succession of anticlinals between Attock on the Indus and the plains of Túrkestán, arranged in lines running more or less from west to east. These are accompanied by outbursts of igneous rocks along far stretching fissures of probably post-cretaceous age amongst which syenitic granite and traps are most conspicuous.

The lines of fissure correspond generally with the direction of the anticlinals, although at several points the reverse is clearly seen. Whether the latter case holds

good in the ranges which form the system of the north-east Hindu Kúsh and the ranges of Kafiristán I cannot say, but think it is probable.

Intrusions along lines of fissures, some of them on a very large scale, are seen in the Hindu Kúsh range, the Paghmán hills, the hills around Kabul and east of that city where they form the eastern Lataband and many of the minor ranges on the route to India.

Anticlinals of the Kara Koh and Karmard.—The high anticlinals of the Kara Koh and the Karmard neighbourhood flatten out considerably as they strike eastwards, forming wide depressed table lands between the lines of folds. Such for instance are the flats south-east of Haibak and Ghorí, which are divided by widely arched anticlinals. South of Ghorí the cretaceous rocks, which form the main mass of the country, rise again into a series of wide arches, which are eventually lost or at least very much obscured by the eruptive rocks of the Hindu Kúsh. The Zind-jitak Kotal for instance leads over one of these wide anticlinals, the southern flank of which is denuded by the system of the Súrkh Rúd. The Hindu Kúsh is formed probably by a system of parallel flexures, which result in a series of separate ranges as it were, but the structure is greatly obscured by intrusive igneous rocks, chiefly hornblendic granite, which has altered the neighbouring formations into metamorphic-schists. The main mass of the Hindu Kúsh is a mighty chain with elevations of from 14 to 16,000 feet even in its south-western portion, and it bears distinct traces of having undergone extensive glaciation in recent geological times.

The eastern half of my last section in Afghánistán belongs to the drainage of the Indus, by the basin of the Kabul river, which with its many affluents has deeply eroded the southern slopes of the Hindu Kúsh and the ranges south and east of it.

The country still bears the same character of great anticlinal folds forming parallel ranges, with intrusions of granite and trap which have metamorphosed the greater part of the sedimentary strata composing these ranges. Here the general strike of the intrusions is across the direction of the anticlinals, being mostly in a line from south-west to north-east, whereas the direction of the anticlinals is nearly uniformly from west to east.

Literature.—The literature relating to matters connected with the geology or mineral resources of Afghánistán is very limited, and is mostly confined to descriptions of places and districts on the frontier or of Southern Afghánistán.

The only authors which I found treating of geological matters connected with Northern Afghánistán are the following :—

P. B. LORD—Some account of a visit to the plain of Koh-i-Dámán, the mining district of Ghorband, and the pass of Hindu Kúsh, &c., Jour. As. Soc. Beng., Vol. VII, page 521.

J. PRINSEP—Report on ten specimens of coal from Capt. Burnes. Jour. As. Soc. Beng., VII, page 848.

MAJOR VICARY—On the geology of the Upper Punjab and Peshawar. Quart. Jour. Geol. Soc., VII, 1851, page 38.

DR. A. FLEMING—On the Geology of part of the Sulimán range. Quart. Jour. Geol. Soc., IX, page 346.

CAPT. HAY—Fossil shells discovered in the neighbourhood of Bajgáh, Afghánistán. Jour. As. Soc. Beng., IX, page 1126.

E. E. DRUMMOND—On the mines and mineral resources of Northern Afghánistán. Jour. As. Soc. Beng., X, page 74.

H. B. MEDLICOTT—On geological specimens from Afghánistán. Proc. As. Soc. Beng., 1880, page 3.

H. B. MEDLICOTT—On rock-salt from the Kuram valley. Proc. As. Soc. Beng., 1880, page 123.

Geology.—The geological structure of the section between Túrústán and Peshawar is simple, in spite of the great changes which have taken place near the numerous intrusions of igneous rocks.

The prevailing rocks belong still to the upper cretaceous period, mostly in the form of hard limestones covering with a thick skin the greater part of the area traversed. Below this, where deep erosion combined with high flexure has exposed the base of the cretaceous series, some members of the older formations appear. The "red grits" and dark shales of the upper jurassics are easily recognized, and are seen at several places; but only at one spot, on the Fazák or Bazák pass north of the Chahárdar pass in the Hindu Kúsh, did I see any rock, which could be identified as older than jurassic. The rock in question is, I believe, carboniferous, and is an eastern continuation of the Palú Kotal (near Bamián) carboniferous limestone.

The greater part of the country between the Hindu Kúsh and Attock shows little more than metamorphic and igneous rocks, in which only here and there shoals, as it were, of the upper beds of the mesozoic series were left intact, and those often are highly metamorphosed.

Part of the return march to India, namely the distance from Shadián to Haibak, was over ground I had already visited and described.¹

Description of section between Shadián and India.—Starting from Shadián, south-east of Balkh, I descended into the Bactryan plain, part of the great valley of the Oxus, now filled with tertiary and recent strata and which is in process of dividing into two separate and parallel valleys.

I have had no better opportunity this time of examining in detail the tertiary beds of Tashkhurghan. In lithological character the Tashkhurghan series is not distinguishable from the Mathar or Bamián rocks. On a base of lower tertiaries and miocene marine clays² rests an enormous thickness of freshwater beds, chiefly buff and reddish coloured hard clays and sandstone, plant shales and grits, belonging to one structural whole and which I include in the pliocene series.

They rest with their older tertiary base conformably on the upper cretaceous (Exogyra) limestone, and are with the latter contorted and raised up, here and there even vertically. Near Tashkhurghan the hard Exogyra limestone beds pass at an angle of about 75° to 80° under the tertiaries, the whole series being favourably exposed by the Tashkhurghan river which forms a transverse valley (one of the finest gorges in Túrústán) through the entire series.

The road to Haibak leads along the valley of this river, which cuts transversely through the whole system of flexures. Apparently there is a wide open synclinal north of Haibak which is bounded on the north by several narrow anticlinals and sharp folds. Inside the synclinal north of Haibak some members of the tertiary

¹ Rec., Vol. XIX, page 235.

² Mr. Ney Elias brought specimens of *Ostrea multicostata*, Desh. var., from the beds of Tashkhurghan. It is a miocene species, identical with similar forms found in the Herat province and at Kilif.

system are inclosed and can easily be distinguished by their bright colouring from the underlying dark grey cretaceous limestone. They form some of the lower slopes of the left (west) side of the valley, north-west of the town of Haibak. I did not examine them closely as they were too far off the line of march.

Near Haibak, where the river flows through this synclinal, it forms a wide and very fertile valley, but further north it cuts through several high anticlinals, producing a transverse valley with precipitous sides, often only a narrow gorge, as for instance near the village of Sáyád and south of Tashkhurghan.

The geological structure is exceedingly well exposed in this gorge, particularly near Sáyád, where the beds of the Exogyra limestone are highly contorted. The lowest portion of the anticlinal is seen to be coarse red grits and brick coloured sandstones of the "red grit group" (upper jurassic or neocomian). The centre of the flexure is just south of the Tashkhurghan gorge and there the red beds dip at a steep angle below the Exogyra limestone, but I question whether I could have made out the true relation of these red grits by simply marching along the route in this gorge. At least from the base of the narrow gorge the true relations of the red grits to the cretaceous limestone are not quite clearly seen. But during our residence at Shadián last summer I observed the same anticlinal at two other points. The Shadián streams erode the cretaceous limestone down to the red grits, which are *in situ* about a mile south of the Tangi Shadián, and they underlie the cretaceous limestone conformably.

To the east of the Shadián valley and parallel with it is the basin of Már-Múl, a picturesque highland valley, surrounded by enormous and precipitous cliffs. Here also the anticlinal is clearly exposed and the red grits are seen to be well developed, forming a thick band of densely red-coloured beds near the centre of the anticlinal; they dip below the outer (northern) flank of the arch, and also disappear below the high cretaceous cliffs which form the southern margin of the Már-Múl valley. The road which leads from Már-Múl over a high kotal into the Tashkhurghan river valley (east of Már-Múl) creeps along the up turned edges of the "red grits."

The Balkh-ab also traverses the same anticlinal, and the structure of it is laid bare on the steep hillsides forming the valley through which the Balkh-ab escapes to the Túrkestán plain. I have not been on the spot itself, but a clear view of the section may be seen from the high points south and south-east of the Shadián valley. The "red grits" are also here laid bare below the overlying Exogyra limestone.

The thick group of limestone beds which rest seemingly conformably on the "red grits" at Shadián and the ground east of it, shows much the same character which distinguishes this formation in other parts of Túrkestán. It forms high precipitous cliffs, generally of a very uniform white to grey, thickly bedded limestone, which besides corals also contains Exogyra, Ostrea, Hippurites sp., Inoceramus, Terebratula, etc.

In some places the limestone is porous, soft and chalky with strings and nests of flints. The upper beds of it are a white porous limestone and shell breccia with many fossils, chiefly bivalves, amongst which a large species of Ostrea is conspicuous. I observed this upper horizon especially well developed at Kafir Kala, about 11 miles south of Shadián, and on the high ground between these points, where

it forms the gently undulating grassy downs which cap the Shadián anticlinal, and then gradually slope down to the synclinal depression south of it.

Lithologically this horizon is identical with the uppermost beds of the cretaceous series of North-West Afghánistán; the cliffs of Houz-i-Khudá, between Chakáu and Kálanáu north of Herat consist of precisely the same rock, and seem also to contain similar fossils. It is quite possible that this portion of the Exogyra limestone series will have to be included in the lower eocene. The latter seems closely connected with the upper cretaceous group in Western Persia and the Armenian frontier and a distinct division between the two formations is nowhere visible.

On the route from Tashkhurghan to Haibak the character of the cretaceous group remains the same throughout, and I believe that the entire thickness (about 2,500 feet) of limestones and marls which composes this formation represents the upper cretaceous horizon. I could not discover any unconformity between the latter and the upper jurassic red grits which are seen to underlie the former near Sáyád, south of Tashkhurghan, at Már-Múl and places west of it. That this is not the case in all sections is well shown in the cliffs immediately south of Haibak, near the village of Doáb, where the unconformity between the red grits and the Exogyra limestone is very marked. (See Records, Vol. XIX, page 249.)

Haibak itself lies in a wide synclinal in which some few remains of tertiary beds are traceable. They form the low slopes and terraces on the left side of the valley, and are evidently conformable to the underlying cretaceous formation.

The road from Haibak to Dahána Ghorí crosses two low kotals, east of the Kotal-i-Archa and a spur which separates the Chasma Shir basin from that of Dahána Ghorí.

Both these kotals cross ranges which are the continuation of the anticlinals of Rui and Doáb, south of Haibak. Between each of them extend wide synclinal troughs, which even become depressed tablelands with nearly horizontal bedding. The latter is well seen between Haibak and the Kotal on the road to Robát. I believe some of the lower cretaceous marls crop up below the Exogyra limestone; the lithological character is precisely identical with the white Baculite marls of Zulfikár and Zorabád. None of the jurassic or older formations crop up along this route.

Near Robát, on the road to Dahána Ghorí, and between the latter place and the Kotal-i-Zinjiták trap dykes, with bosses and strips of syenitic granite traverse the cretaceous limestone. Towards the Kotal-i-Zinjiták the number of these intrusions increases rapidly and they widen in extent. The direction of the dykes runs more or less parallel with the strike of the anticlinals, and south of the Zinjiták Kotal the only prevailing rocks are of igneous nature. One enters there a broad belt of intrusive rocks with some inclusions of semi-metamorphic strata, forming the main range of the Hindu Kúsh between the Súrkh-Rúd and the Ghorband valley.

The same formation of more or less altered strata with intrusions of granite and traps is seen from the south-western corner of Badakhshán to Attock on the Indus. I believe it is possible, however, to distinguish the main divisions of groups in spite of the alteration which has taken place near the contact with the igneous rocks.

How clearly defined the boundary of the igneous belt with the cretaceous limestone is, may be seen from the heights above the Dahána Iskár or from the Kotal-i-

Fazák (elevation above sea-level 10,000 feet), south of the former. Looking back on to the country lying northwards, the dark traps and granitic rocks contrast strongly with the light coloured limestones of the cretaceous formation. The igneous intrusions form quite a network of dark lines near the boundary of the cretaceous limestone, and this can be seen to extend far away east and westwards of the **Zinjiták Kotal**. The boundary runs almost due west and east.

From that point to the Indian frontier there is very little change in the geological structure. The most prominent amongst the igneous rocks of the **Hindu Kúsh** belt is a syenitic granite, apparently of the same lithological character, and belonging to the same mass of intrusion as the granite of the **Northern Ak Robát Kotal**, south of **Saighán**. I found the syenitic granite in great force as a wide belt between **Chahárdar** camping ground and the top of the **Chahárdar** pass 14,100 feet, which leads over the **Hindu Kúsh**. The trend of this belt of granite is almost due west to east and seems to compose the greater part of the **Hindu Kúsh** range. Besides this the entire region between the **Súrkh Rúd** and the top of the **Chahárdar** pass is traversed by numerous granite veins and dykes. The entire series of sedimentary beds which occupy the ground between the granite intrusions has been completely altered by the latter, and has been converted into a succession of metamorphic strata. The prevailing rock is a gneiss with mica schists, but dark coloured phyllites with enclosed indurated limestone are also common. Near **Sar-i-Iskár** great trap masses have intruded in the syenitic granite and are found as dykes throughout the mass of hills, over which the **Kotal-i-Fazák** leads. The top of the latter shows a few fragments or shoals of hard grey limestone, locally converted into a sugar-grained white marble, which I believe (on purely lithological grounds only) to be cretaceous. In that case I may perhaps look upon the metamorphic beds immediately underlying the white marble as representing the "red grits" and the plant-bearing series. Below this section of the metamorphic series, on the south slope of the **Kotal-i-Fazák**, I noticed some beds of very hard splintery, dark limestone, which underlies the metamorphic, subcretaceous series conformably. In it some sections of shells (brachiopods) are visible, and sections of encrinites are not uncommon. It would be difficult to assign any definite age to this limestone, but the lithological character of it is very similar to that of the carboniferous limestone of the **Palú Kotal** near **Bamián**, whilst its geographical position in the strike of the latter would point to the possibility of the palæozoic series also being represented in the **Hindu Kúsh**.

Between this point and the **Koh-i-Dáman** near **Chárikár** the **Hindu Kúsh** is seen to be formed by a succession of anticlinal folds, traversed by igneous rocks, amongst which syenitic granite is again very conspicuous. As the whole complex of sedimentary strata is entirely changed by contact with these intrusive rocks, any correlation with the sedimentary groups of **Túrkistán** must be very uncertain.

As I have shown, the section of the **Fazák** pass may represent the whole series from the carboniferous to the cretaceous formation. The lowest and highest beds of the series at least have some lithological characters in common with these two formations.

Immediately south of the **Fazák Kotal**, near the camping ground of **Chahárdar** great masses of intrusive hornblende granite appear and south of it nothing else is seen but various varieties of the same rock until the top of the **Chahárdar** pass

(14,100 feet) is reached where a few shoals of limestone are enclosed in the granite and have been converted into a fine-grained white marble. South of the pass, on the slopes of the Hindu Kúsh which lead down to the Ghorband valley, large masses, some showing traces of the original structure, of light grey limestone rest seemingly conformably on a series of semi-metamorphic rocks, closely resembling in lithological character the series of the Fazák pass. In the gorge of the Ghorband river between Búrj-i-Gúl Ján and Charikár I also noticed several thin seams of impure graphite in beds of micaceous schist, which resemble the altered beds and graphite seams of the section between Ak Robát and Saighán.

If my supposition is correct that these beds are identical with the Fazák Kotal series and also with the Palú and Ak Robát Kotal section, then it would appear that the carboniferous and supra-carboniferous beds of Saighán strike across the Hindu Kúsh, and form a wide belt of greatly crumpled strata, which have been traversed and intruded by igneous rocks, amongst which the most conspicuous is a hornblendic granite. The belt of the latter, which is only of narrow width north of the Ak Robát Kotal near Saighán, widens out so tremendously that the entire main range of the Hindu Kúsh where I crossed it seems formed of it. It appears therefore that the belt thins out westwards; and in all probability it will be found that in the valley of the Upper Balkh-áb (Rúd-i-Band-i-Amir) a carboniferous section will be found, free from disturbing granite intrusions.

On both sides of the Hindu Kúsh there are also cretaceous rocks (limestones) resting on the older and altered strata; here I could not detect an unconformity, which is very plainly seen in the Bamián Haibak sections.

The remaining distance from Charikár to Peshawar was done by long marches and along a made road, which offered few good opportunities of making geological observations. The valley and basin of Kabul itself is chiefly composed of igneous rocks (hornblendic granite and traps) with some few portions of altered strata, which crop up at a few places near the margin of the valley, and which form the ranges of the Takt-i-Sháh, the Sher Darwaza, the range west and north of the Kabul lake, &c. The valley is filled up by recent and sub-recent formations which form the rich soil for which Kabul has been famous since the earliest times.

Far to the east and north-east, light grey precipitous cliffs are seen to overlie the dark igneous and altered series of Kabul, and I believe I may not be far wrong in identifying these light coloured cliffs with the upper cretaceous, which plays such an important role in the structure of Afghánistán.

The hills of Bútkhák, through which the Kabul river has formed a narrow gorge, the Tangi Gháru, consist of the well-known red grit group with overlying cretaceous limestone of typical character. The section dips east, but I found that the Lataband and the hills eastwards are formed by a succession of anticlinal flexures, some of them exceedingly perfect. The road from Bútkhák over the Lataband pass to Seh-i-Bába leads over a succession of low spurs of altered cretaceous limestone and igneous rocks associated with the latter. The rock *in situ* on each side of the valley at Seh-i-Bába I found to be a dark trap with veins and masses of light green serpentine.

Some of the lower spurs on that route are hidden under thick deposits of sub-recent gravels and reddish clays, which form high level terraces in the Kabul river basin. The road from Seh-i-Bába to the head of the Pari Darra, past Jagdallak

fort and over the Jagdallak pass, leads over the same series of altered strata. Near Jagdallak it is a gneissose schist, highly contorted. Further on the road skirts this formation, passing over a succession of low kotals and undulating ground (Pezwán Kotal, 44th hill, &c.) down to the Gandamak plain.

The greater part of the ground so traversed is composed of sub-recent and possibly pliocene formations. The uppermost portion of them is composed of conglomerates and fine reddish grey sandy clay, very like the aerial (loess) formations of the Chull. The lower beds, which nearly everywhere show a decided south-east dip, are chiefly composed of soft grey (pepper and salt) sandstones and flaggy sandstone-shales with conglomerates. These deposits bear a strong resemblance to the Manchhars and Upper Siwaliks and are quite distinct from the conglomerates and sands, which are discordantly reposing on them.

Between Gandamak and Rozabád the road crosses a series of low spurs all running more or less north or north-east; they are all composed of soft sandstones and conglomerates (Upper Siwaliks) with a rolling dip to the east and are overlaid by horizontally bedded loess and conglomerates of recent origin. The latter forms wide gravelly terraces or low plateaux, ending in steep scarps.

East of Rozabád, the higher ranges come close up to the river, and consist there of altered strata, highly contorted, grey gneissose schists, and intrusions of trap and serpentine, which form quite a network of dykes and veins in the crystalline schists. The same formations are seen to be *in situ* on the opposite side of the Súrkh-áb, in the Siáh-Koh range. The valley widens out to extensive and very fertile alluvial plains near Jalalabád and Chahárdeh. The road skirts the more or less isolated ranges east of Ali Boghán and the hills of Basawal. They consist of altered strata and schists with trap intrusions, and are part of the Siáh-Koh structurally.

The same remarks apply to the spurs which are crossed between Basawal and Dakka on the south side (right bank) of the Kabul river.

Near Haft Cháh, the road enters the narrow valley which leads to the Lundi-Kotal. The prevailing rock is altered limestone (cretaceous?) and schist, amongst the latter a fine-grained grey gneiss with mica schist and greenish grey phyllites. No change of rock is perceptible, excepting that some of the grey limestone near the west entrance into the Khaibar pass seems less altered and closely resembles the upper, cretaceous limestone of Afghánistán. Similar rock is seen near the eastern (Indian) entrance into the Khaibar. I have looked in vain for fossils in any of the rocks. The Khaibar limestone, however, is undoubtedly part of the same limestone formation which forms the Kohat pass and Afridi hills south of the Peshawar plain, which are cretaceous and are overlaid conformably by the nummulitic limestone of the Kohat District.

Notes made during the last war in Afghánistán.—As will be seen from these notes on the country between Kabul and Jamrúd, the section is not a very favourable one; fortunately we possess a few stray notes on the neighbouring areas, collected during the progress of the last war which afford a slight aid in interpreting the structure of this part of Afghánistán.

From specimens¹ which were brought during the last war from Northern Afghán-

¹ H. B. Medlicott, Proc. As. Soc. Beng., 1880, p. 3.

istán, it appears that the north side of the Sikaram in the Saféd Koh range is composed of transition rocks, amongst which magnesian and calcareous beds predominate.

From the western flank of the same hill and from an elevation of about 10,000 feet, Dr. Aitchison brought specimens of unaltered shales with furoid markings. A similar rock is *in situ* on the south side of the peak. From the Shalinar stream, east side of the Paiwar Kotal, a pebble of Lithodendron limestone was brought. The latter is possibly of carboniferous age. It would appear then that beds of palæozoic age accompanied possibly by older mesozoic strata exist in the Saféd Koh range and form the highest part of it. Pebbles of palæozoic rocks, probably of carboniferous age, have been found by Major N. Vicary¹ near the Khaibar mouth near Jamrud and both the locality last named and the Sikaram beds seem to belong to one belt of palæozoic strata, of which the Attock section is the eastern continuation.

The group of altered rocks between Jagdallak, Gandamak, and Ali Boghán may be outliers of the same formation.

Glacial. Recent formations.—In my former paper,² I had occasion to mention some of the deposits and traces of former glaciers in Afghán-Türkistán. Since then I have seen by far the most perfect instances of recent glacial action, when crossing the Hindu Kúsh by the Chahárdar pass in October 1886. The road which leads from Chápdarra camping ground on the north side of the Hindu Kúsh to the top of the pass ascends a narrow straight valley, bounded on each side by steep cliffs, some of them crowned with perpetual snow. The bottom of the valley itself is greatly choked and partially filled with debris, which might be simply the detritus from the hillsides. Large cones and fans of fragmentary material descend from each small ravine on both sides. So far only the configuration of the valley, its nearly straight course and absence of larger side streams, would suggest the former presence of glaciers. But on reaching an elevation of 12,000 feet, one suddenly comes to a huge mass of debris, which closely resembles the recent accumulations near the lower end of a glacier. Large blocks, some of them of immense dimensions, are loosely mingled with angular fragments of every size and the whole is arranged like a dam across the valley. The hillsides (gneiss) are polished and grooved and the blackened surfaces glisten and shine in the distance like metal. All the larger blocks show extensive grooving and deep ice-scratches on their polished sides. This mass of debris lies at the base of a terrace filling the valley. The former glacier, of which this is the end moraine, was on the upper and raised portion of the valley. The latter bears the remarkable appearance of an ice-worn trough; it is wider than the valley below, and its base is now partially filled by finer debris, through which a small stream winds its way amidst a series of swampy pools. It is within the area of perpetual snow and the latter with frozen patches of ice lies on the hillsides and in sheltered depressions.

The valley looks as if the glacier had only quite recently left it. Moraines and glacial silt still lie as they were deposited. The head and catchment area of the valley close to the top of the pass (14,100 feet) is still rather thickly covered with frozen snow.

¹ On the Geology of the Upper Punjab and Peshawar, Quart. Journ. Geol. Soc., VII, p. 38.

² Rec., Vol. XIX, p. 263.

Glacial traces on the south slope of the Hindu Kúsh.—The descent from the Chahárdar pass to the Deh-i-Tang lies down a narrow valley of much the same character as the one just described. But the most interesting feature in connection with it is, that in this valley there are some small glaciers still remaining. Near the head of the valley, just south of the Chahárdar pass, at an elevation of 12,050 feet above sea-level, several small side ravines join; I noticed three of them were still filled with glaciers, and though they were very small, the moraine accumulations near their lower ends were enormous. Especially the one from the right side shoots off an enormous cone of large fragments, amongst which there are some very good examples of ice-scratched blocks.

Recent conglomerates.—Both in Túrkhistán and the neighbouring South-western Badakhshán deposits of recent and sub-recent conglomerates, sands and clays are largely developed. The hills which skirt the cretaceous anticlinals between Hai-bak and Dahána Ghorí are formed by these deposits which attain there a great thickness. Similarly the valley of the Súrkh-áb is partially filled by them.

The valleys belonging to the Kabul river drainage south of the Hindu Kúsh are to a large extent lined with terraces of conglomerates, as, for instance, the wide terraces of Siáh-Gird, Chahárdeh, etc.

These conglomerate terraces form quite a feature in the landscapes of the road east of Kabul, amongst which I may mention the terraces of Gandamak and Nimlah Bagh.

I believe these accumulations belong to the same age as the Indus gravel beds, which are seen to skirt the hills the whole way from Peshawar to Sind.

In the next number of the "Records" I intend giving a geological map of Afghánistán and part of Persia with a summary of the geological structure and mineral resources of Afghánistán.

CALCUTTA, 23rd December 1886.



Physical Geology of West British Garhwal; with Notes on a Route Traverse through Jaunsar Bawar and Tiri-Garhwal, by C. S. MIDDLEMISS, B.A., Geological Survey of India.

PART I.

In Part 2 of the Records for 1885 I described a fossiliferous zone of pre-tertiary age amongst the old mountain-building rocks which form part of the Lower Himalaya of British Garhwal. When that preliminary notice was published I had only been working for a short time in the district, and consequently the area treated of was confined, and no generalizations could be made. Since then, having spent another field season there, I am

Introduction.